Journal of Zoo and Wildlife Medicine 26(3): 387–391, 1995

BLOOD VALUES FOR CAPTIVE GREY DUIKER (*SYLVICAPRA GRIMMIA*) AND BLUE DUIKER (*CEPHALOPHUS MONTICOLA*)

Thomas A. Bailey, B.V.Sc., M.R.C.V.S., Charlotte A. Baker, B.V.Sc., M.R.C.V.S., Philip K. Nicholls, B.V.Sc., M.R.C.V.S., and Kevin Wilson

Abstract: Comparative hematologic and plasma chemistry values were determined in 10 captive blue duikers (*Cephalophus monticola*) and 23 captive grey duikers (*Sylvicapra grimmia*). The animals included both males and females and ranged in age from 5 mo to 7 yr. Blue duikers were anesthetized with medetomidine and ketamine, and grey duikers were anesthetized with medetomidine and ketamine or xylazine and ketamine. Significant differences were found between grey and blue duikers for albumin, creatinine, creatine kinase, magnesium, and total bilirubin.

Key words: Blue duiker, *Cephalophus monticola,* grey duiker, *Sylvicapra grimmia,* hematology, serum chemistry, immobilization.

INTRODUCTION

Duikers belong to a group of antelopes that includes 13 species found throughout the African continent. Although some duikers are an important source of protein for indigenous African people, others are endangered and little studied.[10] As a source of bushmeat, duikers and other game animals are killed and sold with little regard to laws, and in some areas smaller game species such as the duikers may be under considerable pressure as a result of a highly commercialized bushmeat trade.[1] The importance of reference values for hematologic and blood chemistry data in the monitoring of animal health is well established.[2] The International Species Inventory System[5] lists data on blood composition of yellow-backed duiker (*Cephalophus sylvicultor*), bay duiker (*Cephalophus dorsalis*), Maxwell's duiker (*Cephalophus maxwelli*), black duiker (*Cephalophus niger*), blue duiker (*Cephalophus monticola*), and grey duiker (*Sylvicapra grimmia*). However, in some instances the mean values are based on only a single individual or a small number of serum components. This report provides baseline blood data for both grey and blue duiker.

MATERIALS AND METHODS

In this study, which is part of the Pan-African Decade of Duiker Research,[11] we examined the plasma biochemical and hematologic values of 10 blue duikers and 23 grey duikers. All animals were kept at the Duiker Research and Breeding Centre at Chipangali Wildlife Trust near Bulawayo, Zimbabwe. Of the 23 grey duikers, three were obtained from wild stock and had been in captivity for at least 2 yr, and the remainder were born in captivity. Two of the blue duikers were from wild stock and had been in captivity for at least 5 yr, and the remainder were captive bred. Blue duikers were housed in 10- × 10-m shaded enclosures and fed a diet of mixed fruits, including apples, oranges, and bananas, supplemented by a pelleted game ration containing lucerne, alfalfa, and maize. The grey duikers were housed in 30- × 30-m partially shaded enclosures and fed a mixed fruit diet with at least 10 different species of native leaves. One blue duiker and three grey duikers were pregnant. During August 1991, blood samples were collected by venipuncture from blue duikers chemically immobilized with medetomidine hydrochloride (Domitor, SmithKline Beecham Animal Health, Tadworth, Surrey KT20 7NT, U.K.) and ke-

From the Animal Pathology Division, Department of Clinical Veterinary Medicine, University of Cambridge, Madingley Road, Cambridge CB3 0ES, U.K. (Bailey, Baker, Nicholls); and the Chipangali Wildlife Trust, P.O. Box 1057, Bulawayo, Zimbabwe (Wilson).

Table 1. Age and gender distribution of blue and grey duikers.

	No. males	No. females	Age $\bar{x} \pm$ SD (yr)	Age Range
Blue duiker	7	3	2.7 ± 2.3	5 mo–7 yr
Grey duiker	18	5	3.0 ± 2.3	2 wk–7 yr

tamine hydrochloride (Vetalar, Parke, Davis and Co., Pontypool, Gwent NP4 0YH, U.K.). During the same period, blood was collected from grey duikers chemically immobilized with either medetomidine and ketamine or xylazine (Rompun, Bayer U.K., Newbury, Berkshire RG13 1JA, U.K.) and ketamine. Atipamezole hydrochloride (Antisedan, SmithKline Beecham Animal Health) was used as an antagonist to xylazine and medetomidine. The average dose of anesthetic for blue duiker was 190 μg/kg medetomidine and 2.2 mg/kg ketamine administered i.m. using a Telinject blowdart system (Telinject UK, Littleborough, Lancashire OL15 9EG, U.K.). The average dose of anesthetic for grey duiker was 14.6 mg/kg of xylazine with 12.2 mg/kg of ketamine also administered i.m. through a Telinject dart. With the grey duiker, effective immobilization was only achieved with higher dosages (average effective immobilization dose was 16.4 mg/kg of xylazine with 13.1 mg/kg of ketamine). None of the animals sampled had food or water witheld prior to blood sampling.

Immobilized duikers were examined clinically, and feces were collected from the rectum. The fecal samples were screened for nematode eggs using a flotation technique, and egg counts were performed using McMaster's technique[3] on all positive samples.

Blood was collected by venipuncture with a 23-gauge 1-inch needle on a 5-ml disposable syringe. Samples were transferred into EDTA tubes, lithium heparin tubes, or oxalate tubes and refrigerated at approximately 4°C until processing. Heparinized samples were centrifuged within 30 min of collection and analyzed immediately or frozen at −20°C in 2-ml aliquots in plastic ampules. Frozen samples were analyzed within 48 hr of collection. Red and white cells were counted using an improved Neubauer counting chamber. Packed cell volume was measured using a microhematocrit centrifugation technique. Analyses for total protein, albumin, blood urea nitrogen (BUN), creatinine, creatine kinase (CK), alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma glutamyl transferase (GGT), Mg, Ca, and total bilirubin were performed with a programmable flow-cell spectrophotometer (Beckman Model 42 spectrophotometer, Beckman Instruments, High Wycombe, Bucks HP12 4JL, U.K.). Na and K were measured with an ion-selective electrode (Beckman E2A analyzer, Beckman Instruments). A miniphotometer (Ames Minilab T, Bayer Diagnostics, Basingstoke RG21 2YE, U.K.) was used for analysis of glucose, triglyceride, cholesterol, and hemoglobin. BUN was measured on the miniphotometer, and total solids were measured using refractometry. A further estimate of blood glucose was made using a dipstick technique (Clinistix, Ames Division, Bayer Diagnostics). Quality control of all procedures was carried out using reference sera (Decision Level 1-3, Beckman Instruments). Results for grey and blue duiker were compared statistically using t-tests.

RESULTS

No major lesions were found on any of the duikers in this study. Some animals showed mild ectoparasitism, and three duikers had nematode eggs in the feces, with counts ranging from 7,140 to 15,200 eggs/g. Nematodes obtained postmortem from one grey duiker (CD4) euthanized for management reasons, were identified as *Setaria* sp., probably *S. hornbyi* (L. F. Khalil and L. M. Gibbons, pers. comm.). Only female specimens were present, and in the absence of males it was not possible to confirm the species identification. One grey duiker had superficial cutaneous abrasions probably of

Table 2. Blood values for captive male and female blue duikers.

Parameter	*n*	Mean	SD	Range
Total protein (g/dl)	10	5.72	0.76	4.5–7.6
Total solids (g/dl)	10	5.76	0.88	5.0–7.8
Albumin (g/dl)	10	3.70	0.71	2.76–5.00
BUN (mg/dl)				
Minilab T	10	21.4	7.69	12.5–40.0
Beckman M42	10	18.3	6.59	11.5–34.1
Creatinine (mg/dl)	10	0.7	0.11	0.6–0.9
Creatine kinase (IU/L)	9	382	244	119–866
ALT (IU/L)	10	11.7	5.53	4.3–17.6
AST (IU/L)	10	158	124	63–468
GGT (IU/L)	10	40.9	17.6	15.1–66.7
Magnesium (mg/dl)	10	2.28	0.41	1.44–2.76
Calcium (mg/dl)	10	10.1	0.92	8.84–11.64
Sodium (mEq/L)	10	134	4.7	123–139
Potassium (mEq/L)	10	4.05	0.39	3.33–4.63
Total bilirubin (mg/dl)	10	0.34	0.24	0.094–1.10
Glucose (mg/dl)				
Dipstick	10	175	43.2	132–250
Minilab T	10	186	36.0	132–236
Cholesterol (mg/dl)	10	100	23.2	57.9–120
Triglycerides (mg/dl)	10	25.7	8.9	14.2–41.6

traumatic origin. No nematode eggs were found in the feces of any of the blue duikers.

The sex distributions and age ranges of blue and grey duikers are given in Table 1. Plasma chemistry values are presented in Tables 2 and 3. Tables 4 and 5 include the hematologic values.

The two methods of BUN analysis pro-

Table 3. Blood values for captive male and female grey duikers.

Parameter	*n*	Mean	SD	Range
Total protein (g/dl)	23	5.7	1.14	4.0–9.0
Total solids (g/dl)	23	5.4	0.87	3.8–7.6
Albumin (g/dl)	23	3.16	0.64	2.07–4.56
BUN (mg/dl)				
Minilab T	23	19.4	9.3	12.7–50.4
Beckman M42	23	17.1	10.1	11.3–52.1
Creatinine (mg/dl)	23	1.2	0.4	0.7–2.5
Creatine kinase (IU/L)	21	858	813	163–3060
ALT (IU/L)	23	10.5	12.5	0.9–62.3
AST (IU/L)	23	101	48	14–248
GGT (IU/L)	23	38.2	12.9	8.9–64.8
Magnesium (mg/dl)	23	2.74	0.89	1.49–5.21
Calcium (mg/dl)	23	10.1	1.6	6.8–13.9
Sodium (mEq/L)	23	137	5.2	124–147
Potassium (mEq/L)	23	4.4	1.0	3.5–8.2
Total bilirubin (mg/dl)	22	1.0	0.7	0.3–2.5
Glucose (mg/dl)				
Dipstick	20	155	45	90–250
Minilab T	20	153	50	81–258
Cholesterol (mg/dl)	23	97	26	54–158
Triglycerides (mg/dl)	23	27	22	9–99

Table 4. Hematology values for captive male and female blue duikers.

Parameter	n	Mean	SD	Range
Hemoglobin (g/dl)	10	17.8	1.4	15.7–20.3
Packed cell volume (%)	10	47	3.2	41–53
Red cell count ($10^6/\mu l$)	10	9.5	0.7	8.2–10.4
White cell count ($10^3/\mu l$)	10	2.8	0.8	1.6–4.0
MCV (fl)	10	49	3.6	44–57
MCHC (g/dl)[a]	10	38	4.5	34–50
MCH (pg)	10	18	2.6	15–25

[a] Mean corpuscular hemoglobin concentration.

Table 5. Hematology values for captive male and female grey duikers.

Parameter	n	Mean	SD	Range
Hemoglobin (g/dl)	22	17.8	2.2	13.9–21.8
Packed cell volume (%)	23	47	5.5	38–59
Red cell count ($10^6/\mu l$)	22	9.0	1.5	6.7–11.9
White cell count ($10^3/\mu l$)	21	2.9	1.9	0.8–8.1
MCV (fl)	22	53	5.0	43–60
MCHC (g/dl)[a]	22	37	3.5	27–42
MCH (pg)	21	20	2.9	16–25

[a] Mean corpuscular hemoglobin concentration.

duced similar results. The dipstick and minilab T results for blood glucose analysis were also very similar.

Statistical comparison of results showed no significant differences between grey and blue duikers for hematologic parameters. For the plasma chemistry analyses, there were significant differences for five components. Blue duikers appeared to have a slightly higher level of albumin than did grey duikers ($P < 0.05$). Creatinine ($P < 0.001$) and CK ($P < 0.05$) were higher in grey than in blue duikers, as were Mg ($P < 0.05$) and total bilirubin ($P < 0.05$).

DISCUSSION

This study provides reference values for plasma biochemical and hematologic components for grey and blue duikers. Additionally, significant differences were found between grey and blue duikers for several blood components, namely albumin, creatine, CK, Mg, and total bilirubin. Differences in albumin values may result from dietary factors such as starvation or malnutrition, altered protein digestion, absorption or loss due to gastrointestinal disease, reduced synthesis due to liver disease, or loss through proteinuria in renal disease. Creatinine levels may be altered by changes in the glomerular filtration rate, and Mg levels may vary due to dietary factors. High total bilirubin values can be due to hemolysis or liver disease. None of the animals examined showed evidence of systemic disease, so the exact causes of differences among individuals and between species remain speculative.

Some of the blood components showed a wide standard deviation. CK had a broad range in grey duikers presumably because of the increased excitability of these animals as compared with blue duikers. The chemical immobilization of grey duikers was in general less effective than that of blue duikers, and therefore the degree of excitement seen upon induction in some grey duikers may have been responsible for the higher level of CK observed in these animals. The grey duiker is typically an inhabitant of open savannah grasslands and is prone to a flight reaction when approached. Even after being maintained in captivity for some years, many grey duikers still maintain this flight reaction and may run into the enclosure fences if approached suddenly. Hand rearing will allow individuals to become habituated to humans (V. J. Wilson, pers. comm.). In this study, some duikers showed a marked flight response after darting, sometimes resulting in mild superficial abrasions from collision with enclosure fences. Duikers in adjacent enclosures would sometimes become excited by the flight reaction of a darted grey duiker, and this may be the reason for the high levels of CK or AST observed in some individuals. CK has been useful as an indicator of stress response during capture in other species;[6] in this study, grey duikers had greater mean and maximum levels of CK. The mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) in blue duiker were higher than those previously reported,[7] whereas the red and white cell counts were lower. In the blue duiker, total protein, ALT, GGT, Na, and K were lower, and glucose was higher than previously reported.[7] Glucose has been reported as a sensitive indicator of stress during capture,[4] and the higher levels of glucose seen in this study may reflect the low degree of handling to which the blue duikers were accustomed. The immobilization of blue duikers was characterized by a very smooth induction period, although the blood glucose values were still similar to those in grey duikers, which had a less smooth induction.

Different methods of analysis may result in different values for blood components according to the type of test used. In addition, factors such as age, sex, intercurrent disease, diet, and husbandry systems may alter the composition of blood and should be taken into consideration when using data for reference purposes.[8,9] The absence of nematode eggs in feces probably reflects the success of daily removal of feces from the enclosure for parasite control.

Acknowledgments: We thank Mr. V. J. Wilson, director of the Duiker Research and Breeding Centre, and his family for hosting this work and all the staff for assisting with data collection and animal handling. SmithKline Beecham Animal Health, Bayer, U.K., and Parke Davis and Company provided the sedative agents, and Beckman Instruments provided the Model 42 spectrophotometer and E2A analyzer with technical support. We thank British Airways Assisting Nature Conservation for assistance with freight and flight arrangements. The parasite identification was undertaken by Dr. L. F. Khalil and Dr. L. M. Gibbons of the International Institute of Parasitology, St. Albans, Herts, U.K. This work was carried out under research permit number 01666 issued by the Department of National Parks and Wildlife Management, Zimbabwe.

LITERATURE CITED

1. Anadu, P. A., P. O. Elamah, and P. O. Oates. 1988. The bushmeat trade in southwestern Nigeria; a case study. Hum. Ecol. 16: 199–208.

2. Bennett, P. M., S. C. Gascoyne, M. G. Hart, J. K. Kirkwood, and C. M. Hawkey. 1991. Development of LYNX: a computer application for disease diagnosis and health monitoring in wild mammals, birds and reptiles. Vet. Rec. 128: 496–499.

3. Dunn, A., and A. Keymer. 1986. Factors affecting the reliability of the McMaster technique. J. Helminthol. 60: 260–262.

4. Hattingh, J. 1988. Comparative quantitation of the physiological response to acute stress in impala and roan antelope. Comp. Biochem. Physiol. 89A: 547–551.

5. ISIS. 1991. International Species Inventory System. Minnesota Zoological Garden, Apple Valley, Minnesota.

6. Kock, M. D., R. du Toit, N. Kock, D. Morton, C. Foggin, M. La Grange, and B. Paul. 1990. Effects of capture and translocation on biological parameters in free-ranging black rhinoceros (*Diceros bicornis*) in Zimbabwe. J. Zoo Wildl. Med. 21: 414–424.

7. Roeder, B. L., G. C. Loop, and J. E. Johnson. 1990. Comparative hematologic and serum chemistry values for neonatal, juvenile and adult blue duiker (*Cephalophus monticola bicolor*). J. Zoo Wildl. Med. 21: 433–446.

8. Roeder, B. L., G. A. Varga, and R. F. Wideman, Jr. 1991. Effect of dietary calcium and phosphorus on mineral metabolism and acid–base balance in blue duiker antelopes. Small Ruminant Res. 5: 93–107.

9. Roeder, B. L., R. F. Wideman, Jr., and G. A. Varga. 1993. Effects of varied dietary calcium and phosphorus on renal function of male blue duikers. Small Ruminant Res. 11: 17–32.

10. Vietmayer, N. D. 1985. Potentials of microlivestock in developing countries. J. Appl. Rabbit Res. 8: 10–11.

11. Wilson, V. J. 1983. Ten Year Survey of the Duikers of Africa (1985–1994). Chipangali Wildlife Trust, Bulawayo, Zimbabwe.

Received for publication 2 June 1994